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Real Time Positioning

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EMERGING CONSTRUCTION TECHNOLOGIES

Sensors – Construction Equipment & Methods

REAL TIME POSITIONING

THE NEED

Construction operations involve location and positioning elements in the field. These activities are typically performed by surveyors and inspectors using traditional equipment such as theodolites, levels, and chains or tapes. These traditional methods are laborious, time consuming, expensive and open to errors when the data is gathered, transcribed and processed.

THE TECHNOLOGY

There are two primary components to the system; transmitters and receivers.

FIGURE 1 TRANSMITTERS (LEFT) & RECEIVERS(RIGHT)

The system requires a minimum of two transmitters. Each transmitter is set on a tripod with a front plate such that light can be scattered about the site. A battery is used to power the unit, and each 12 volt battery will operate a transmitter for 30 hours. The system can also be directly wired to a standard outlet with the addition of an AC to DC converter.

The set up of the transmitters can be very quick and imprecise. The transmitters can be set up at unknown points with the face plate generally aimed at the site. This can be thought of as setting up a spotlight which is generally aimed at the site to be illuminated. However, the energy source is infra-red which will allow only receivers to "see' the "light". The site would require several known points to be established within the area of the site to be used to back-calculate the position of the transmitters.

The receiver is comprised of a computer and screen, two optical lenses mounted on a pole, a battery which is mounted on the pole, and a data entry retrieval system. The two

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optical lenses form a line. The position of the lenses and the known geometry of the pole allow the point position definition to be projected to the end of the pole. Therefore, the position of any point that the user touches with the device is accurately and "instantly" captured. Note that the position of the pole does not change if the pole is slanted, rotated, upside down or sideways. The system can be directly linked to CAD and the receiver becomes a three dimensional cursor within the CAD environment.

The Benefits

The system allows multiple users to work at the same time once the system is set up. These users can include surveyors, craftpeople, and equipment operators each of whom is working concurrently and using the positioning system to capture accurate real-time position information about the work environment. The various users work from the same set of transmitters and can determine their position if they can "see" any two transmitters. If the system is connected to CAD, it will provide a real-time link between the physical and virtual design worlds.

The system will work indoors, outdoors, under obstacles, in urban environments, under water, on land, in the dark and in space. Also it is not affected by changes in temperature or humidity nor by human sighting error. This greatly reduces human error prevalent in current measurement techniques. In other words the implementation of this system can result in higher productivity, better quality, less rework and improved safety.

Status

A first system has been developed and commercialized. Ongoing research and development will focus on the improvement of its primary capabilities. The system currently provides 1:10,000 accuracies, 5 updates per second, and has a working range of 130 meters. The next generation is expected to be of millimeter accuracy over 200 meters with a 10 to 20 Hz data rate. Longer and higher rates are anticipated.

It is expected that the system will work in many markets alongside current measurement equipment as an added tool in the overall measurement toolkit. These other market segments include: measurement for object placement and as-built creation, control of equipment, robotics or remotely operated vehicle control and, modeling of surfaces.

Barriers

The primary limitation of the system is the distance achieved. This can be partially negated by adding cascading areas of control. This will allow individuals to move from one part of a large site to another. Continuity of measurement can be established. As sensor and laser technology matures in areas of visible light and other light frequencies, distance will increase.

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Reviewers

Peer reviewed as an emerging construction technology

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